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Burner, particularly for liquid or gaseous fuels

The invention relates to a burner, particularly for liquid or gaseous fuels, having a fuel nozzle which is centrally disposed in a burner pipe and surrounded by a catchment element also disposed in the burner pipe, which element separates the combustion air that is fed through the burner pipe into a central main stream that flows through the catchment element, and a secondary stream that flows around the catchment element, whereby the main stream and the secondary stream are brought together again behind the fuel nozzle, in the region of the burner flame.

In the case of a known burner of the stated type, according to the state of the art (DE 196 10 106 A1), the catchment element is adjustable relative to the burner pipe and the fuel nozzle. In this adjustment, the cross-sections for the main stream and the secondary stream change at the same time, whereby the position of the catchment element relative to the fuel nozzle also changes at the same time. The simultaneous change in the two passage cross-sections, with the simultaneous change in the position of the catchment element relative to the fuel nozzle, is disadvantageous, because the fuel nozzle, which lies in the

main stream, requires fixed cross-section conditions and, in particular, an unchanging spatial constellation between the fuel nozzle and the catchment element, for optimal operation.

It is therefore the task of the invention to develop the burner of the type stated initially further, in such a manner that the fuel nozzle that lies in the main stream always works under optimal conditions, and that the burner flame is essentially stabilized by means of control-technology intervention in the secondary stream. By means of this stabilization of the flame, as complete as possible a combustion is supposed to be achieved, with the simultaneous avoidance of NOx emissions.

To accomplish this task, the invention proposes, proceeding from the burner of the type stated initially, that the catchment element is arranged stationary relative to the fuel nozzle, has the shape of the shell of a double truncated cone, and leaves a flow cross-section for the main stream that first narrows and then widens again, as well as a flow cross-section for the secondary flow that first widens and then narrows again, whereby the upper edge and the lower edge of the catchment element form control edges, and the catchment element is surrounded by a pipe-shaped annular throttle that is movable in an axial

direction in the burner pipe, which throttle has two control collars that protrude towards the inside and are located across from the control edges of the catchment element, to control the amount of combustion air that is transported in the secondary stream.

In the case of the burner according to the invention, the geometrical relationships in the region of the fuel nozzle remain essentially the same, in particularly advantageous manner. Because of the special configuration of the catchment element, the main stream accelerates at first, until it reaches its greatest speed in the region of the center of the shell of the double-truncated cone, i.e. just ahead of the fuel nozzle. In this way, the fuel exiting from the fuel nozzle is swirled particularly well, and thoroughly mixed with combustion air, so that a flame that burns in stable manner, to a great extent, is formed, which exits from the catchment element at the end of the latter. For the combustion air combusted in the secondary stream, the flow conditions are the opposite. Here, a high flow velocity first occurs, between the control collar of the annular throttle and the intake-side control edge of the catchment element, and this subsequently slows down accordingly in the widening flow cross-section, thereby building up higher static

pressure there. On the outflow side, the combustion air transported in the secondary stream is accelerated again, in order to pass through between the control edge of the catchment element on the outflow side, and the related control collar of the annular throttle. Behind this narrowest cross-section on the outflow side, this combustion air mixes with the combustion air transported in the main stream, and here assures complete combustion, without residues.

In a preferred embodiment of the burner according to the invention, the inflow-side control edge of the catchment element and the inflow-side control collar of the annular throttle lie close to one another. In this way, the result is achieved that in the "start" position, almost all of the combustion air reaches the fuel nozzle by way of the main stream, so that there, particularly intensive atomization of the fuel occurs, thereby facilitating the ignition and start of the burner.

Another important characteristic of the invention provides that in the "open" position (normal operation), the control edges of the catchment element and the control collars of the annular throttle that lie opposite them leave passage gaps between them of approximately the same size, whereby the inflow-side control

collar of the annular throttle lies ahead of the inflow-side control edge of the catchment element, seen in the flow direction. In this way, it becomes possible to recirculate part of the combustion gases that occur, which are inert, to a great extent, into the main stream, and this has an advantageous effect on the completeness of the combustion. This recirculation becomes possible because pressure conditions that result from the cross-sectional shape of the flow channel in the secondary stream occur there, which conditions promote recirculation.

Another important characteristic of the invention provides that in the "full load" position, the gap left between the inflow-side control edge of the throttle element and the related control collar of the annular throttle is smaller than the gap left between the outflow-side control edge of the catchment element and the related control collar of the annular throttle, whereby the inflow-side control collar of the annular throttle lies behind the inflow-side control edge of the catchment element, seen in the flow direction. This results in particularly intensive and thorough mixing, particularly when the main stream and the secondary stream combine, and this

assures the completeness of combustion, particularly during a full load.

An exemplary embodiment of the invention will be explained in greater detail below, making reference to the drawing. This shows:

Fig. 1: in a fundamental diagram, a longitudinal cross-section through the burner according to the invention, in the "open" position (normal operation);

Fig. 2: in the same representation as Figure 1, the burner according to the invention in the "start" position;

Fig. 3: in the same representation as Figure 1, the burner according to the invention in the "full load" position.

In the drawing, the burner pipe, which is graduated in diameter, is indicated with the reference symbol 1. A fuel nozzle 2 is disposed centrally in the burner pipe, and supplied with liquid

or gaseous fuel by a central feed pipe 3. The burner pipe 1 is supported on the central feed pipe 3 by means of radially running spokes 4 and 5.

The fuel nozzle 2 is provided with an electrical ignition mechanism 6, which serves to ignite the burner flame.

A catchment element 7 is rigidly connected with the fuel nozzle 2. This catchment element 7 has the shape of a shell of a double-truncated cone and surrounds the fuel nozzle 2 concentrically.

The catchment element 7 in turn is surrounded by an essentially cylindrical annular throttle 8 that is movable in an axial direction inside the burner pipe. A displacement drive, not shown, which passes through an opening 9 in the burner pipe, serves to move the annular throttle 8 axially.

The main stream of the combustion air runs through the interior of the catchment element and thereby acts directly on the spray stream of the fuel nozzle 2 at the lower end of the catchment element. The secondary stream of the combustion air is passed

through the annular space between the catchment element 7 and the annular throttle 8.

To control the combustion air in the secondary stream, the catchment element 7 is provided with control edges 7a and 7b on the inflow side and the outflow side. The wall of the catchment element 7 runs between these control edges 7a and 7b, seen in the flow direction, at first conically diverging and then progressively diverging. This results in a flow cross-section for the main stream of the combustion air that first narrows and then widens again.

The secondary stream of the combustion air runs between the outside of the catchment element 7 and the inside of the annular throttle 8, which is provided with control collars 8a and 8b that protrude radially towards the inside and correspond to the control edges 7a and 7b of the catchment element 7. The particular shape of the catchment element 7, in interaction with the shape of the annular throttle 8, results in a flow cross-section for the secondary stream that first widens and then narrows again, the inflow and outflow of which is controlled by the control edges 7a and 7b and the control collars 8a and 8b.

Finally, the catchment element 7 is also provided with a crown of bores 10 on the outflow-side end, which bores serve to recirculate combustion air. This recirculation is illustrated with the arrow 11 in Figure 1.

Finally, a fuel injection 12 that is assigned to the ignition mechanism 6 is located in the upper end of the catchment element 7; this facilitates the ignition process.

In Figure 1, the annular throttle 8 is in the "open" position (normal operation), in which the control edges 7a and 7b of the catchment element 7 and the control collars 8a and 8b of the annular throttle 8 that lie across from them leave passage gaps between them of approximately the same size, whereby the inflow-side control collar 8a of the annular throttle lies in front of the inflow-side control edge 7a of the catchment element 7, seen in the flow direction. In this position, particularly intensive recirculation of combustion air takes place, as is indicated by the arrow 11.

In Figure 2, the annular throttle 8 is in the "closed" position, in which the inflow-side control edge 7a of the catchment element 7 and the inflow-side control collar 8a of the annular

throttle 8 lie next to one another. In this position, the secondary stream is throttled down to almost zero, and the entire combustion air flows in the main stream, resulting in particularly fine atomization of the fuel, thereby facilitating the ignition process.

Finally, Figure 3 shows the throttle element 8 in the "full load" position, in which the gap left between the inflow-side control edge 7a of the catchment element 7 and the related control collar 8a of the annular throttle 8 is smaller than the gap left between the outflow-side control edge 7b of the catchment element 7 and the related control collar 8b of the annular throttle 8, whereby the inflow-side control collar 8b of the annular throttle 8 lies behind the inflow-side control edge 7a of the catchment element 7, seen in the flow direction. In this position, particularly intensive and thorough mixing of the main stream and the secondary stream takes place, so that complete combustion is guaranteed even under full load.